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September 26, 1991

**CRUISE RESULTS**  
**NOAA SHIP MILLER FREEMAN**  
**Cruise No. 91-01**  
Echo Integration-Midwater Trawl Survey  
of Pollock in the Bering Sea

**CRUISE PERIOD, AREA, AND SCHEDULE**

Scientists from the Alaska Fisheries Science Center (AFSC) conducted an echo integration-midwater trawl (EIMWT) survey of walleye pollock (Theragra chalcogramma) aboard the NOAA ship Miller Freeman from January 31 to March 18, 1991, for a total of 46 sea days. The cruise began in Seattle, Washington, and ended in Dutch Harbor, Alaska. The areas of operations included Shelikof Strait and the region near Chirikof Island in the Gulf of Alaska, the eastern Bering Sea shelf, and the Bogoslof Island region. The vessel's itinerary was as follows:

Leg 1

Jan 31-Feb 1	Gear tests and sphere calibration in Puget Sound
Feb 1-7	Transit to Kodiak [including 12 hr of Pacific Marine Environmental Laboratory (PMEL) work and a touch and go in Ketchikan to disembark PMEL scientists]
Feb 7-8	Embark scientists and offload gear in Kodiak
Feb 9	Transit to Malina Bay
Feb 9-10	Malina Bay sphere calibration
Feb 10-12	EIMWT survey of portions of Shelikof Strait and the region near Chirikof Island
Feb 13-14	Transit to Bering Sea
Feb 15	Touch and go in Dutch Harbor to embark scientist
Feb 15-22	EIMWT survey of southeast Bering Sea shelf



Feb 23	Touch and go in Dutch Harbor to embark scientists
Feb 23-Mar 3	EIMWT survey of Bogoslof Island region
Mar 4	Cannery Bay sphere calibration
Mar 5-6	Inport Dutch Harbor

### Leg 2

Mar 7	Transit to Bogoslof Island region
Mar 7-10	EIMWT survey of a portion of the Bogoslof Island region
Mar 10-15	Ichthyoplankton survey of Bogoslof Island region
Mar 15	Touch and go in Dutch Harbor to exchange scientists End of MF91-1

### **OBJECTIVES**

The principal objectives of the cruise were to:

1. Collect echo integration data and midwater and demersal trawl data necessary to determine the distribution, biomass, and biological composition of walleye pollock in the areas of operations.
2. Collect pollock target strength data for use in scaling echo integration data to estimates of absolute abundance.
3. Collect ichthyoplankton samples in the Bogoslof Island region to determine the distribution and abundance of pollock eggs; collect plankton samples in this area to examine protein concentrations in Bering Sea plankton.
4. Collect bile and stomach samples in the Bering Sea and Gulf of Alaska to document the exposure of pollock to oil contamination.
5. Conduct tests of PMEL oceanographic equipment in preparation for Fisheries-Oceanography Coordinated Investigations (FOCI) work scheduled later in the spring.
6. Collect genetic tissue samples (partial pollock ovaries, blood) and morphometric photographs of pollock for stock structure studies.
7. Spawn mature pollock from the Bogoslof Island area and culture fertilized pollock eggs for laboratory experiments on larval pollock growth rate and metabolism.

8. Calibrate both the towed body and the hull-mounted acoustic systems using standard sphere techniques.

### VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship Miller Freeman, a 66 m (216 ft) stern trawler, equipped for fisheries and oceanographic research. Two 38 kHz echo sounding systems were used: one employing a Simrad<sup>1</sup> split beam transducer attached to the vessel's centerboard and the other a towed body system with a Biosonics split beam transducer. The Simrad transducer was mounted on the distal end of the centerboard at a depth of 10 m below the surface with the centerboard fully extended. The Biosonics transducer was housed in a dead-weight fin and towed at a depth of 10-15 m below the surface approximately 60 m behind the vessel. The Simrad transducer was connected to a Simrad EK500 echo sounding system. The Biosonics transducer was connected to a custom developed transmitter and receiver interfaced with a Hewlett Packard 1000 computer. System electronics were housed in a portable laboratory mounted on the weather deck of the vessel. Data from the Simrad EK500 echo sounder/receiver were processed using Simrad BI500 echo integration and target strength data analysis software on a SUN workstation computer. Acoustic data from the Biosonics system were processed using the Hewlett Packard 1000 computer.

Midwater echo sign was sampled using a modified Northern Gold 1200 midwater rope trawl (NET Systems, Inc.). The trawl was constructed with ropes in the forward section and stretch mesh sizes ranging from 163 cm (64 inches) immediately behind the rope section to 8.9 cm (3.5 inches) in the cod end. It was fitted with a 3.2 cm (1.25 inch) mesh cod end liner. Headrope and footrope lengths were 94.5 m (310 ft) and 50 m (164 ft), respectively, and the breastlines measured 79.4 m (260.5 ft). The net was fished in a bridleless configuration with 1.8 m X 2.7 m (6 ft X 9 ft) steel V-doors and 227 kg (500 lb) tom weights on each side. Trawl mouth opening and depth were monitored with a Furuno wireless netsounder system attached to the headrope of the trawl.

Three additional nets were used. Fish on and near bottom were sampled with an 83/112 bottom trawl without roller gear. The bottom trawl had mesh sizes ranging from 10.2 cm (4 inches) forward to 8.9 cm (3.5 inches) in the cod end and a 3.2 cm (1.25 inch) cod end liner. Headrope and footrope lengths were 25.6 and 34.1 m (83.9 ft and 111.9 ft), respectively. Breastlines measured 3.4 and 3.2 m (11.3 and 10.5 ft). A Marinovich midwater trawl, with meshes measuring 7.6 cm (3.0 inches) forward and 3.2 cm in the cod end, and a 0.32 cm (1/8 inch) cod end liner was used to sample smaller fish. Headrope and footrope lengths were each 9.1 m (30 ft). The

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<sup>1</sup> Reference to trade names or commercial firms does not constitute U.S. government endorsement.

Marinovich trawl and the 83/112 demersal trawl were fished with the same steel V-doors used with the rope trawl. Fish larvae and zooplankton were sampled with a 60 cm (23.6 inch) dual Bongo net with 333 micron mesh.

Water temperature/salinity profile data were collected at trawl and calibration sites using a Seabird CTD (conductivity/temperature/depth) system. Expendable bathythermographs (XBT) were launched routinely during the survey period to provide additional temperature profile data. The surface temperature was measured with a bucket thermometer at each trawl location.

### SURVEY METHODS

The 1991 winter EIMWT survey began in the Gulf of Alaska. After receiving reports of high pollock abundance from commercial fisherman and domestic observers, AFSC scientists conducted an exploratory survey on the Kodiak side of Shelikof Strait, where most of the pollock had been taken during the fishery a couple of weeks before. A trackline of zigzag transects extending 5-10 nautical miles (nmi) offshore was run from Alligator Island (58°30' N) at the north end of the Strait to Sturgeon Head (57°30' N) in the south (Figure 1). At Sturgeon Head, two parallel transects 12.5 nmi apart were run across the strait. Next, the vessel transitted to an area east of Chirikof Island to survey the region and collect pollock samples for the oil contamination study. A trackline of zigzag transects was conducted through an offshelf area south and east of Chirikof Island (Figure 1). This area was the site of an intense commercial fishery in March 1989. From here, the vessel transitted to an offshelf area south of Sanak Island in the hopes of encountering fish to provide more biological samples for the oil contamination study. In order to save time, acoustic data for all Gulf of Alaska work were collected with the hull-mounted system only; the towed body system was not deployed. Echo sign was sampled only with the rope trawl.

Ice conditions in the Bering Sea forced a change in the survey itinerary. The original plan was to begin the Bering Sea work in the area northwest of the Pribilof Islands. Because sea ice already covered much of the shelf in this region, it was decided to first survey the area southeast of the Pribilofs which was relatively ice-free. A set of parallel transects 30 nmi apart was run from north of Umnak Island to just west of St. George Island (Figure 2). These parallel lines extended from off the shelf (approximately 550 m bottom depth) inshore to about 82 m or the ice edge--whichever came first. Five of the seven transect lines were shortened on the inshore side due to the presence of ice floes. For most of the Bering Sea work, both acoustic systems were used. Echo sign on the shelf was sampled with midwater and bottom trawls (Figure 3).

The vessel then moved to the region surrounding Bogoslof Island to survey pollock spawning concentrations. Parallel transects oriented north-south were spaced 10 nmi apart extending from 167° W longitude westward to 170°12' W longitude (Figure 4). Echo sign was sampled with the midwater rope trawl and at one location (haul 20) with the Marinovich trawl and Bongo net (Figure 5). Immediately after the first pass through, we re-surveyed the area of concentrated fish sign using six parallel transects spaced 10 nmi apart and offset 5 nmi from the first survey (Figure 6). After exchanging scientists in Dutch Harbor, Alaska, the vessel conducted a final EIMWT pass through the Bogoslof Island region (Figure 7) and an ichthyoplankton survey of the same region, including adjacent shelf waters (Figure 8).

Survey operations were conducted during day and night. Vessel speed averaged about 11 knots and varied between 6 and 12 knots, depending upon weather conditions. Except when noted otherwise, echo integration data from both acoustic systems provided surface density ( $\text{kg/m}^2$ ) estimates for pollock.

Midwater and demersal trawl hauls were made at selected locations to identify echo sign and provide biological samples. The average trawling speed was about 3 knots. Vertical net opening for the midwater rope trawl averaged 20 m and ranged between 18-25 m. Horizontal net spread measured with the Scanmar system during gear trials in Puget Sound was about 37 m. Vertical net opening for both the midwater Marinovich and the 83/112 bottom trawl averaged 3 m. Standard catch sorting and biological sampling procedures were used to provide estimates of weight and number by species for each haul. Walleye pollock were further sampled to determine sex, length, weight, age, maturity, gonad weight, and stomach composition. Other pollock samples were preserved for stock structure and oil contamination studies. Length frequencies for pollock from Shelikof Strait and the Bogoslof area were computed by calculating proportions of pollock at length for each haul in the area from the random length samples and then averaging the proportions.

Standard sphere calibrations were conducted in Puget Sound prior to departure for Alaska, in Malina Bay at the start of Leg I, and in Cannery Bay at the end of Leg 1 (Table 1). At each location, the vessel was anchored fore and aft in 80-100 m of water. Calibration involved suspending a copper sphere with known acoustic properties 30 m below the transducer. Data were collected with the Biosonics system at several fin depths to measure any changes in system sensitivity due to pressure effects.

## PRELIMINARY RESULTS

### Standard Sphere Calibrations

During the Puget Sound calibration (Table 1), split beam target strength and echo integration data were collected from the standard sphere with the Simrad hull-mounted system. Data were also collected to describe the beam pattern characteristics of the Simrad EK500 transducer. The towed body system was not calibrated.

In Malina Bay, system gain and beam pattern measurements were collected for the Simrad system. Measurements revealed no significant change from the Puget Sound calibration. Split beam and echo integration data on the copper sphere were collected with the transducer positioned at depths of 10, 15, and 20 m for the towed body system. Unfortunately, weather conditions during this phase of calibration caused the vessel to swing. The only acceptable data were acquired at the end of the day at a transducer depth of 10 m. These data yielded an equipment scaling constant similar to the value at 10 m observed during the 1990 calibrations.

In Cannery Bay on March 4, calibration began with a system gain check of the Simrad system. Since no significant change in gain was observed, it was decided to postpone beam pattern measurements to a later date and concentrate on data collection for the towed body system. Measurements on the standard sphere were made at several fin depths between 10 and 20 m. Results agree rather well with those obtained from the 1990 sphere calibrations.

### Biological and Oceanographic Data Collection

Biological and oceanographic samples and experiments for numerous studies at the AFSC and other laboratories were collected or conducted during the cruise. Oceanographic tests of PMEL/FOCI equipment were successfully carried out during transit from Seattle to Kodiak, Alaska. Trawl station and catch data from 32 midwater and 3 bottom trawl hauls are summarized in Table 2. Table 3 describes 26 Bongo haul stations, where samples were collected to estimate pollock egg distribution and to determine protein composition of Bering Sea zooplankton. Pollock contributed the highest percentage of species present in trawl hauls, both by weight and numbers, in all areas surveyed (Tables 4-7). Major non-pollock components of midwater hauls were eulachon in the Gulf of Alaska and jellyfish on the Bering Sea shelf. Arrowtooth flounder and rock sole contributed to species composition in the bottom hauls (Table 6). Tallies of biological data collected for pollock are presented in Tables 8 and 9. A total of 58 CTD casts (Table 10) and 49 XBT casts (Table 11) were made.

### Shelikof Strait Exploratory Survey

An exploratory survey of Shelikof Strait was conducted on February 9-12. Domestic observer reports, along with information from commercial fishermen, revealed that most of the trawling during the winter Shelikof fishery had occurred on the Kodiak side of the Strait, as opposed to the mainland side. The Kodiak side was thus selected for investigation. Pollock sign was encountered from the north end of Alligator Island south to Sturgeon Head and also on the two cross-Strait transects at the south end. Densities observed appeared similar to those observed during the 1988-1990 winter surveys.

Three midwater tows were made to sample echo sign. Lengths of pollock encountered in hauls ranged from 10 cm to 59 cm, with modes at approximately 12, 20, 30, and 50 cm (Figure 9). Hauls 1 and 3 captured pollock of similar sizes and maturities. Haul 2 had no fish less than 40 cm in length and included a number of large individuals of maturity stage 2 (developing). For all three hauls combined, 75-100% of male and female pollock over 34 centimeters in length were in pre-spawning condition (mature but not yet spawning) (Figure 10).

### Chirikof and Sanak Survey

Transects were run through an offshelf region south and east of Chirikof Island on February 12. Very little fish sign was encountered. A single midwater haul (haul 5, Table 2) was made to collect pollock samples for the oil contamination study. Pollock ranged from 46 to 59 cm in length (Figure 9) and were nearly all pre-spawning (Figure 10). An area surveyed off the shelf near Sanak Island did not reveal any densities which were adequate for sampling.

### Southeast Bering Sea Shelf Survey

The Bering Sea shelf southeast of the Pribilof Islands was surveyed on February 15-22 (Figure 2). Pollock were observed on all seven transects. The highest densities of pollock were encountered in the Pribilof Canyon area south of St. George Island (Figure 2). Substantial echo sign was encountered at the ice edge between transects 5 and 6. However, trawling was not possible there due to the presence of floating ice.

Twelve midwater tows and three demersal tows were made (Figure 3). Size compositions observed on the shelf were mixed. Some catches contained only adult fish, while others were dominated by juvenile fish (ages 1 and 2, approximately 12 cm and 22 cm in length, respectively). Most juvenile pollock were found near the shelf/slope edge (hauls 8, 9, 12, 13, 14, and 18, Figure 3). We observed that age 1 fish captured in haul 12 had an average length of 11 cm, while year-old fish caught in haul 13

were 13 cm on average. There was less overlap in length than we expected for these samples, suggesting perhaps the fish experienced different feeding or growth environments, temperature regimes, or had different birth dates. Very few fish between 28 and 37 cm were observed. Pollock obtained in midwater hauls ranged from 8 to 66 cm in length, while pollock from bottom hauls ranged from 12 to 78 cm (Figure 11). In midwater hauls, most adult pollock were in a pre-spawning reproductive stage (Figure 10). Bottom hauls captured some actively spawning females, although the majority of females were pre-spawning. The majority of males obtained in the three bottom hauls were actively spawning (Figure 10). Maturity-at-length data for southeast shelf females from midwater and bottom hauls combined (Figure 12) suggested that 50% maturity occurred at a length of about 41 cm. Too few data were collected to evaluate length at 50% maturity for males.

### Bogoslof Island Surveys

During Leg 1, the spawning pollock region surrounding Bogoslof Island was surveyed from February 23 to March 3 (Leg 1, Figures 4 and 6). Aggregations of pollock were found between 167°30' W and 169°30' W longitudes. Concentrations of pollock were encountered throughout the water column; from 30 m below the surface to 700 m. In the northern part of the Bogoslof area, pollock concentrations were found in the upper 250 m of the water column, whereas in the southern part of the region, fish were found below 250 m. Biological differences between these two types of pollock layers were not apparent, and a preliminary examination of temperature and salinity data did not provide an obvious explanation of the observation. More thorough comparisons of oceanographic data and pollock depth distribution will be made during the next stage of data analysis. Preliminary analyses of echo integration data indicated a decline in biomass in this region compared to results from 1988 and 1989.

A combined total of 12 midwater trawl hauls were made (Figure 5). Lengths of pollock from hauls in this region ranged from 22 cm to 62 cm, with an average length of 49.9 cm (Figure 13). Most fish caught in the Bogoslof region were larger than 40 cm (Figure 13), although in haul 20, which was made east of the main spawning area, a number of 2-year-old pollock were captured. During the first pass, most of the pollock were in a pre-spawning reproductive stage, whereas during the replicate survey, some actively spawning male and female fish were found (Figure 13). Fertilized eggs cultivated from pollock collected during pass 2 were sent to the AFSC for larval pollock growth rate and metabolism studies.

During the final EIMWT survey near Bogoslof Island (Leg 2, March 7-10, Figure 5), more spawning (stage 4) and spent (stage 5) pollock were present than had been observed in that

region during Leg 1. However, a major portion of female pollock were still in pre-spawning condition (stage 3) (Figure 13). The last haul of the survey (haul 35), made on March 10, was east of the main Bogoslof area. Fish from this haul were slightly smaller on average than the other Bogoslof fish sampled, but they were all in either spawning or spent condition. The haul was made in relatively deep water and included species that reflected both basin and shelf fauna.

The ichthyoplankton survey conducted March 10-15 in the Bogoslof area (Figure 8) revealed very low concentrations of eggs at most stations. The only significant concentrations were observed at stations 6, 7, 8, 18, and 20, south and east of Bogoslof Island.

#### SCIENTIFIC PERSONNEL

<u>Name</u>	<u>Sex/ Nationality</u>	<u>Position</u>	<u>Organization</u>
Puget Sound (January 31-February 1)			
Neal Williamson	M/USA	Chief Scientist	AFSC
Dan Twohig	M/USA	Elec. Technician	AFSC
John Garrison	M/USA	Elec. Technician	AFSC
Jim Traynor	M/USA	Fish. Biologist	AFSC
James Schumacher	M/USA	Oceanographer	PMEL
David Kachel	M/USA	Oceanographer	PMEL
Taina Honkalehto	F/USA	Fish. Biologist	AFSC
Marie Schall	F/USA	Phys. Sci. Tech.	PMEL
			(Jan 31)
Dennis Shields	M/USA	Computer Scientist	ONCO
			(Jan 31)
Dave King	M/USA	Gear specialist	AFSC
			(Jan 31)
Dave Roetcisoender	M/USA	Biol. Technician	AFSC
			(Jan 31)
Transit (February 1-7)			
Dan Twohig	M/USA	Chief Scientist	AFSC
James Schumacher	M/USA	Oceanographer	PMEL
			(Feb 1-4)
David Kachel	M/USA	Oceanographer	PMEL
			(Feb 1-4)

<u>Name</u>	<u>Sex/ Nationality</u>	<u>Position</u>	<u>Organization</u>
Leg 1 (February 7-March 5)			
Neal Williamson	M/USA	Chief Scientist	AFSC
Daniel Twohig	M/USA	Elec. Technician	AFSC
Dennis Benjamin	M/USA	Fish. Technician	AFSC
Taina Honkalehto	F/USA	Fish. Biologist	AFSC (Feb 15-Mar 5)
Claire Armistead	F/USA	Fish. Biologist	AFSC
John Garrison	M/USA	Elec. Technician	AFSC (Feb 7-23)
Stormy Stoots	M/USA	Fisherman	ADA (Feb 9-11)
Joseph Klein	M/USA	Biol. Technician	AFSC (Feb 23-Mar 5)
Xianshi Jin	M/China	Fish. Biologist	YSFRI (Feb 23-Mar 5)
Nikolai Fadeev	M/USSR	Fish. Biologist	TINRO (Feb 23-Mar 5)

## Leg 2 (March 6-15)

Jim Traynor	M/USA	Chief Scientist	AFSC
Ed Nunnallee	M/USA	Fish. Biologist	AFSC
Dan Twohig	M/USA	Elec. Technician	AFSC
John Garrison	M/USA	Elec. Technician	AFSC
Joe Klein	M/USA	Biol. Technician	AFSC
Xianshi Jin	M/China	Fish. Biologist	YSFRI
Nikolai Fadeev	M/USSR	Fish. Biologist	TINRO
Young Hee Hur	F/Korea	Fish. Biologist	NFRDA
Yoshimi Takao	M/Japan	Fish. Engineer	NRIFE
Denise Adams	F/USA	Fish. Biologist	AFSC

AFSC - Alaska Fisheries Science Center, Seattle, WA  
 PMEL - Pacific Marine Environmental Laboratory, Seattle, WA  
 ONCO - Office of NOAA Corps Operations, Seattle, WA  
 TINRO - Pacific Research Institute of Fisheries and Oceanography  
 Vladivostok, USSR  
 YSFRI - Yellow Sea Fisheries Research Institute, Qingdao, China  
 ADA - Alaska Driggers Association, Kodiak, AK  
 NRIFE - National Research Institute of Fisheries Engineering,  
 Tokyo, Japan  
 NFRDA - National Fisheries Research and Development Agency,  
 Kyoungsangnam-do, Republic of Korea

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Table 1. Standard sphere calibration summary for the Miller Freeman cruise 91-1.

Date	Location	Transducer depth (m)	
		System 1 (Towed body)	System 2 (Centerboard mounted)
Jan. 31- Feb. 1	Port Susan, Puget Sound, WA	no calibration	10
Feb. 9-10	Malina Bay, Kodiak Island, AK	10, 15, 20	10
Mar. 4	Cannery Bay, Unalaska Island, AK	5, 10, 12.5, 15, 20	10

Table 2. Midwater trawl station and catch data from Miller Freeman cruise 91-1.

HAUL NO	AREA	DATE (1991)	TIME (AST)	START POSITION		TEMP. (C)		DEPTH (FM)		CATCH (LBS/NOS.)		
										WALLEYE POLLOCK	EULACHON	OTHER
1	SH	11 FEB	0956-1000	58 4.1	153 37.4	3.2	5.1	118	130	4083/6470	259/3055	35/28
2	SH	11 FEB	1845-1943	57 36.0	154 35.7	3.3	3.4	50	92	2448/1097	1/6	7/5
3	SH	12 FEB	0256-0306	57 28.2	155 14.0	2.1	4.9	109	139	1050/1440	22/334	225/30
4	CH	12 FEB	2237-2259	55 59.8	154 24.2	3.4	5.3	201	258	169/64		40/6
5	SE	15 FEB	1613-1642	54 49.9	165 37.2	1.9	4.0	85	86	2426/1350		17/3
6	SE	16 FEB	0124-0154	55 28.3	163 57.2	2.6	-	40	48	243/135		6917/5
7	SE	16 FEB	1334-1349	56 15.1	163 34.4	1.6	1.6	49	49	8010/3213		2058/2416
8	SE	17 FEB	1921-2006	55 13.2	167 42.3	2.2	4.1	130	133	734/4359		3/3
9	SE	17 FEB	2131-2141	55 13.0	167 42.4	2.2	4.1	131	131	283/228		1299/863
10	SE	18 FEB	0639-0649	55 53.6	165 58.8	1.7	2.1	38	63	4170/2563		41/0
11	SE	18 FEB	2013-2030	56 17.9	166 42.1	1.6	4.4	48	59	1809/925		100/1
12	SE	19 FEB	1209-1220	55 50.7	167 45.9	1.6	4.4	63	71	92/5169		201/3
13	SE	19 FEB	1909-1909	55 42.9	168 50.6	1.7	3.8	120	151	42/425		8/1
14	SE	19 FEB	2024-2049	55 43.4	168 50.9	1.6	3.8	92	210	590/2974		6/2
15	SE	20 FEB	1033-1121	56 10.1	168 46.0	1.4	3.7	265	419	650/449		213/5
16	SE	21 FEB	0113-0123	56 33.3	168 55.9	1.4	2.3	31	55	944/561		152/2
17	SE	21 FEB	0558-0559	56 18.2	169 35.3	0.9	2.3	36	88		No catch	
18	SE	21 FEB	0837-0840	56 18.3	169 34.0	1.7	4.2	56	90	309/1368		256/0
19	SE	21 FEB	2046-2058	56 31.5	170 38.8	1.0	3.2	63	63	1302/419		486/370
20	BG	24 FEB	0250-0321	54 14.0	167 17.1	2.2	3.7	244	820	238/117		18/15
21	BG	25 FEB	0353-0554	53 43.5	168 8.1	3.1	3.5	197	590	1391/686		2/2
22	BG	25 FEB	1434-1451	54 29.9	168 8.7	3.1	3.6	118	820	17/10		0/0
23	BG	25 FEB	2208-2235	54 4.7	168 28.4	3.0	3.7	124	1259	236/106		3/4
24	BG	26 FEB	2245-2254	53 50.0	168 46.1	3.3	3.4	97	1137	1555/640		2/3
25	BG	27 FEB	0127-0147	53 49.5	168 45.6	3.3	3.7	113	1137	15/7		2/7
26	BG	27 FEB	1054-1121	54 1.2	169 2.5	3.3	3.6	124	1107	2263/1088		9/4
27	BG	27 FEB	1833-1916	53 11.1	169 2.4	3.3	3.4	286	519	1881/882		14/25
28	BG	27 FEB	2111-2141	53 13.4	169 1.8	3.4	3.2	383	429	1272/612		3/56
29	BG	1 MAR	2228-2243	53 55.8	169 10.4	3.5	3.0	13	1050	20000/9692		0/0
30	BG	2 MAR	1210-1240	53 29.3	168 53.5	3.7	3.7	194	1000	926/470		0/0
31	BG	3 MAR	1311-1312	54 13.2	168 1.0	3.3	2.8	44	900	2990/1390		3/3
32	BG	8 MAR	0458-0629	53 51.1	169 27.5	3.2	2.8	42	911	424/234		3/7
33	BG	9 MAR	0644-0727	53 01.7	169 17.6	3.8	3.6	191	454	1326/692		19/6
34	BG	10 MAR	1353-1421	53 37.1	168 27.1	3.5	3.7	186	647	1022/732		1/1
35	BG	15 MAR	0206-0243	54 22.8	166 09.2	3.1	3.8	223	341	917/655	1/4	6/5

Note: hauls 7, 9, and 19 are bottom trawls, and haul 25 is a Marinovich trawl. Areas are coded as follows:  
 SH, Shelikof Strait, CH, Chirikof, SE, southeast Bering Sea shelf, and BG, Bogoslof Island area.

Table 3. Bongo trawl station data from the winter 1991 Bering Sea pollock survey, Miller Freeman cruise 91-1.

STATION NO	DATE (1991)	TIME (GMT)	START POSITION		DEPTH (M)		DURATION (MIN)	COMMENT
			LAT. (N)	LONG. (W)	GEAR	BOTT		
G001A	11 MAR	0427	53 07.7	169 00.0	250	273	25.38	
G002A	11 MAR	0708	53 30.0	168 58.9	530	1857	54.02	trace eggs <sup>1</sup>
G003A	11 MAR	1102	54 00.2	169 00.0	622	2220	56.33	eggs noted <sup>2</sup>
G003B	11 MAR	1237	54 00.0	169 00.0	598	2000	54.07	Shaw sample <sup>3</sup>
G004A	11 MAR	1652	54 31.0	169 00.2	577	1500	41.95	
G005A	11 MAR	2303	54 09.9	167 59.2	616	1991	54.17	
G005B	12 MAR	0015	54 10.1	167 59.4	655	1992	52.58	Shaw sample
G006A	12 MAR	0359	53 40.4	168 00.9	543	710	40.93	eggs noted
G007A	12 MAR	0916	54 03.0	167 00.9	500	780	51.38	eggs noted
G008A	12 MAR	1237	54 33.2	167 00.8	459	459	52.72	
G008B	12 MAR	1336	54 33.1	167 00.4	417	464	35.75	eggs noted
G008C	12 MAR	1425	54 33.3	167 01.9	352	463	35.75	Shaw sample
G009A	12 MAR	1837	54 38.9	168 00.4	526	1300	48.25	
G010A	12 MAR	2206	55 08.0	168 01.3	494	1086	52.53	
G010B	12 MAR	2320	55 08.0	168 00.8	463	1020	52.63	Shaw sample
G011A	13 MAR	0321	55 02.5	167 01.4	127	155	15.32	
G012A	13 MAR	0638	55 33.2	167 00.5	106	130	12.18	
G013A	13 MAR	1027	55 48.7	166 00.0	87	118	11.05	
G014A	13 MAR	1345	56 00.5	165 00.4	66	92	9.45	
G015A	13 MAR	1708	55 31.7	165 00.0	79	104	9.60	
G016A	13 MAR	2035	55 05.5	164 59.2	59	104	9.38	
G017A	14 MAR	0108	55 22.5	165 59.9	*	120	10.63	
G018A	15 MAR	0100	54 19.9	166 01.6	491	550	46.25	eggs noted
G019A	15 MAR	0405	54 48.9	166 00.0	158	165	15.70	
G019B	15 MAR	0429	54 49.2	165 59.8	155	160	15.47	Shaw sample
G020A	15 MAR	0737	54 26.5	166 31.3	520	541	44.17	eggs noted

\* Bongo gear hit bottom. <sup>1</sup> probably not pollock eggs. <sup>2</sup> pollock eggs observed in bongo haul sample. <sup>3</sup> bongo haul collected for Mr. William Shaw, Pacific Biological Station, Nanaimo, BC, Canada, for a study of protein content of zooplankton.

Table 4. Summary of catch by species in four midwater trawls from the Gulf of Alaska portion of the winter 1991 pollock survey, Miller Freeman cruise 91-1.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lbs.)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	9071	72.4	7749.1	92.9
Eulachon ( <u>Thaleichthys pacificus</u> )	3395	27.1	282.7	3.4
Pacific Sleeper Shark ( <u>Somniosus pacificus</u> )	1	<.1	200.0	2.4
Arrowtooth Flounder ( <u>Atheresthes stomias</u> )	1	<.1	2.0	<.1
Giant Grenadier ( <u>Albatrossia pectoralis</u> )	3	<.1	29.0	0.4
Smooth Lumpsucker ( <u>Aptocyclus ventricosus</u> )	10	0.1	45.0	0.5
Lanternfish Unidentified (Myctophidae)	-	-	0.3	<.1
Chinook Salmon ( <u>Oncorhynchus tshawytscha</u> )	7	0.1	11.3	0.1
Rougheye Rockfish ( <u>Sebastes aleutianus</u> )	3	<.1	10.0	0.1
Jellyfish Unidentified (Scyphozoa)	2	<.1	3.0	<.1
Shrimp Unidentified	20	0.2	0.5	<.1
Squid Unidentified	<u>22</u>	<u>0.2</u>	<u>6.0</u>	<u>0.1</u>
Totals	12535	100.0	8338.9	100.0

"-" indicates that individuals were not counted.

Table 5. Summary of catch by species in eleven midwater trawls from the southeast shelf region obtained during the winter 1991 Bering Sea pollock survey, Miller Freeman cruise 91-1.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lbs.)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	20278	99.9	12005.9	60.3
Jellyfish Unidentified (Scyphozoa)	-	-	7640.8	38.4
Pacific Lamprey ( <u>Lampetra tridentata</u> )	2	<.1	2.3	<.1
Pacific Sleeper Shark ( <u>Somniosus pacificus</u> )	2	<.1	210.0	1.1
Arrowtooth Flounder ( <u>Atheresthes stomias</u> )	1	<.1	1.8	<.1
Rock Sole ( <u>Lepidopsetta bilineata</u> )	2	<.1	2.0	<.1
Pacific Cod ( <u>Gadus macrocephalus</u> )	2	<.1	27.0	0.1
Smooth Lumpsucker ( <u>Aptocyclus ventricosus</u> )	4	<.1	12.3	0.1
Lanternfish Unidentified (Myctophidae)	-	-	0.1	<.1
Eulachon ( <u>Thaleichthys pacificus</u> )	1	<.1	0.1	<.1
Chinook Salmon ( <u>Oncorhynchus tshawytscha</u> )	1	<.1	0.2	<.1
Prowfish ( <u>Zaprora silenus</u> )	5	<.1	2.0	<.1
Rougheye Rockfish ( <u>Sebastes aleutianus</u> )	1	<.1	10.0	0.1
Salps Unidentified (Thaliacea)	-	-	4.5	<.1
Totals	20299	100.0	19919.0	100.0

"-" indicates that individuals were not counted.

Table 6. Summary of catch by species in three bottom trawls from the southeast shelf region obtained during the winter 1991 Bering Sea pollock survey, Miller Freeman cruise 91-1.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lbs.)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	3860	50.7	9595.2	71.4
Rock Sole ( <u>Lepidopsetta bilineata</u> )	1530	20.1	1187.4	8.8
Arrowtooth Flounder ( <u>Atheresthes stomias</u> )	809	10.6	1166.4	8.7
Flathead Sole ( <u>Hippoglossoides elassodon</u> )	606	8.0	398.8	3.0
Pacific Cod ( <u>Gadus macrocephalus</u> )	292	3.8	458.7	3.4
Skate Unidentified (Rajidae unident.)	7	0.1	65.0	0.5
Alaska Skate ( <u>Bathyraja parmifera</u> )	4	0.1	3.9	<.1
Pacific Halibut ( <u>Hippoglossus stenolepis</u> )	62	0.8	88.5	0.7
Rex Sole ( <u>Glyptocephalus zachirus</u> )	8	0.1	16.0	0.1
Yellowfin Sole ( <u>Limanda aspera</u> )	82	1.1	75.3	0.6
Alaska Plaice ( <u>Pleuronectes quadrituberculatus</u> )	75	1.0	103.4	0.8
Sturgeon Poacher ( <u>Podothecus acipenserinus</u> )	18	0.2	6.3	0.1
Sculpin Unidentified (Cottidae)	1	<.1	1.0	<.1
Yellow Irish Lord ( <u>Hemilepidotus jordani</u> )	2	<.1	3.0	<.1
Plain Sculpin ( <u>Myoxocephalis jaok</u> )	27	0.4	31.4	0.2
Bigmouth Sculpin ( <u>Hemitripterus bolini</u> )	2	<.1	46.0	0.3
Icelus sp.	2	<.1	0.2	<.1
Capelin ( <u>Mallotus villosus</u> )	1	<.1	0.1	<.1
Chinook Salmon ( <u>Oncorhynchus tshawytscha</u> )	2	<.1	7.0	0.1
Jellyfish Unidentified (Scyphozoa)	24	0.3	10.8	0.1
Sea Anemone Unidentified (Actinaria)	5	0.1	1.5	<.1
Shrimp Unidentified	-	-	0.1	<.1
Bairdi Tanner Crab ( <u>Chionoecetes bairdi</u> )	40	0.5	37.9	0.3
Opilio Tanner Crab ( <u>Chionoecetes opilio</u> )	72	1.0	56.1	0.4
Hermit Crab Unidentified (Paguridae)	27	0.4	6.0	<.1
Red King Crab ( <u>Paralithodes camtschatica</u> )	24	0.3	47.0	0.4
Snail Unidentified (Gastropoda)	25	0.3	5.5	<.1
Bivalve Unidentified (Pelecypoda)	1	<.1	0.1	<.1
Basket Star ( <u>Gorgonocephalus caryi</u> )	-	-	19.0	0.1
Sponge Unidentified	-	-	0.8	<.1
Totals	7608	100.0	13438.4	100.0

"-" indicates that individuals were not counted.

Table 7. Summary of catch by species in sixteen midwater trawls from the Bogoslof Island region obtained during the winter 1991 Bering Sea pollock survey, Miller Freeman cruise 91-1.

<u>Species</u>	<u>Numbers</u>	<u>Percent</u>	<u>Weight (lbs.)</u>	<u>Percent</u>
Walleye Pollock ( <u>Theragra chalcogramma</u> )	18013	99.2	36470.4	99.8
Pacific Lamprey ( <u>Lampetra tridentata</u> )	6	<.1	5.5	<.1
Robust Blacksmelt ( <u>Bathylagus milleri</u> )	9	0.1	0.6	<.1
Northern Smoothtongue ( <u>Leuroglossus schmidtii</u> )	11	0.1	0.3	<.1
Pacific Viperfish ( <u>Chauliodus macouni</u> )	1	<.1	0.1	<.1
Smooth Lumpsucker ( <u>Aptocyclus ventricosus</u> )	15	0.1	45.6	0.1
Snailfish Unidentified (Cyclopteridae)	2	<.1	4.0	<.1
Lanternfish Unidentified (Myctophidae)	61	0.3	2.5	<.1
Smelt Unidentified (Osmeridae)	1	<.1	0.1	<.1
Eulachon ( <u>Thaleichthys pacificus</u> )	4	<.1	1.0	<.1
Jellyfish Unidentified (Scyphozoa)	18	0.1	14.1	<.1
Shrimp Unidentified	1	<.1	0.1	<.1
Squid Unidentified	13	0.1	6.9	<.1
Salps Unidentified (Thaliacea)	-	-	3.0	<.1
Totals	18155	100.0	36554.2	100.0

"-" indicates that individuals were not counted.

Table 8. Summary of the numbers of biological samples and measurements taken by US scientists. A, for U. Alaska tissue bank, B, for T. Mulligan, U. Alaska, C, for K. Bailey, AFSC. P/O, photo/otolith.

HAUL NO	LENGTH	MATUR.	OTOL.	FISH WGTS	GONAD WGTS	STOMACH SCANS/ SAMPLE	--MITOCHONDRIAL DNA-GENETICS SAMPLES--				STOCK STRUCTURE		
							BLOOD	BUFFERED OVARY	OVARY SAMPLES A	B	C	P/O	BILE
1	351	99	99	99	44	-	-	-	-	-	-	-	-
2	325	65	65	65	59	-	-	-	-	-	-	-	-
3	295	89	89	88	24	-	-	-	-	-	-	-	-
4	34	49	49	34	33	-	-	-	-	-	-	-	15
5	337	85	85	85	77	27/0	-	-	-	-	-	-	-
6	96	-	-	-	-	-	-	-	-	-	-	-	-
7	271	100	100	100	84	-	-	-	-	-	-	0/10	-
8	143	19	19	19	-	-	-	-	-	-	-	0/7	-
9	228	79	57	79	42	-	-	-	-	-	-	-	-
10	417	89	89	89	84	-	-	-	-	-	-	0/10	15
11	333	74	74	-	-	-	-	-	-	-	-	-	-
12	224	-	-	-	-	-	-	-	-	-	-	-	-
13	425	-	-	-	-	-	-	-	-	-	-	-	-
14	115	33	33	33	31	-	32	20	20	20	-	-	-
15	353	96	96	96	86	-	-	-	-	-	-	15/15	-
16	301	84	84	84	82	-	18	30	30	30	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-
18	239	30	30	16	10	-	-	-	-	-	-	-	-
19	244	52	52	52	49	-	25	25	-	25	-	6/6	-
20	117	44	44	44	42	-	-	-	-	-	-	-	-
21	329	103	44	103	103	10/0	-	-	-	-	-	-	-
22	10	10	10	10	10	-	-	-	-	-	-	10/0	-
23	106	106	106	105	104	-	-	-	-	-	-	-	15
24	297	53	53	52	53	-	25	25	25	25	-	-	-
25	7	-	-	-	-	-	-	-	-	-	-	-	-
26	388	88	88	88	86	-	25	25	25	25	-	-	-
27	242	122	122	60	60	-	-	-	-	-	-	21/21	-
28	242	47	-	47	47	-	-	-	-	-	-	-	-
29	303	106	106	63	63	-	-	-	-	-	-	-	-
30	278	129	129	73	72	-	-	-	-	-	-	15/15	-
31	297	78	20	-	-	-	-	-	-	-	-	11/11	-
32	234	100	-	100	99	67/13	-	-	-	-	-	-	-
33	210	179	79	179	95	-	-	-	-	-	-	10/10	-
34	238	105	-	-	-	-	-	-	-	-	17	-	-
35	358	108	-	-	-	-	-	-	-	-	-	-	-
TOT	8387	2421	1822	1863	1539	104/13	125	125	100	125	17	88/105	45

Table 9. Summary of the numbers of biological samples and measurements taken by scientists from People's Republic of China (PRC), the USSR, and South Korea (ROK), Miller Freeman cruise 91-1.

HAUL NO.	NATION	LENGTH	MAT.	OTOL.	GONAD WTS	FISH WTS	MUSCLE TISSUE
21	PRC	33	24	33	33	33	-
	USSR	33	30	33	33	33	-
24	PRC	28	21	28	28	28	-
	USSR	32	14	32	32	32	-
26	PRC	32	18	32	32	32	-
	USSR	34	14	34	34	34	-
28	PRC	47	6	47	47 <sup>1</sup>	47 <sup>1</sup>	-
29	USSR	41	41	41	40	41	-
32	ROK	100	100 <sup>1</sup>	100 <sup>1</sup>	99 <sup>1</sup>	100 <sup>1</sup>	100
33	ROK	100	100 <sup>1</sup>	100 <sup>1</sup>	95 <sup>1</sup>	100 <sup>1</sup>	100
34	PRC	14	14	14	-	14	-

<sup>1</sup> Included in US sample numbers in Table 8.

Table 10. Inventory of CTD casts made during the winter 1991 Bering Sea pollock survey, Miller Freeman cruise 91-1.

CAST NO.	HAUL NO.	DATE (1991)	TIME (AST)	POSITION		DEPTH (m)	COMMENT
				LAT (N)	LONG (W)	CAST/BOTTOM	
1	-	Feb 1	0910	48 08.1	122 22.3	59/70	Port Susan cal
2	-	Feb 10	1558	58 13.2	153 00.5	91/110	Malina Bay cal
3	1	Feb 11	1049	58 04.1	153 35.7	210/232	Shelikof Strait
4	2	Feb 11	2040	57 33.9	154 38.6	147/159	Shelikof Strait
5	3	Feb 12	0400	57 28.2	155 15.1	240/465	Shelikof Strait
6	5	Feb 15	1743	54 49.1	165 39.3	151/162	T 1.0 EBS shelf
7	6				NO DATA		Bad cast
8	7	Feb 16	1510	56 15.8	163 32.8	77/84	T 2.0 EBS shelf
9	8&9	Feb 17	2039	55 12.9	167 42.4	235/247	T 3.0 EBS shelf
10	10	Feb 18	0759	55 53.9	165 59.5	103/116	T 3.0 EBS shelf
11	11	Feb 18	2346	56 18.2	166 42.2	99/108	T 4.0 EBS shelf
12	12	Feb 19	1326	55 51.1	167 46.2	124/129	T 4.0 EBS shelf
13	13&14	Feb 19	2222	55 42.9	168 50.7	270/280	T 4.1 EBS shelf
14	15	Feb 20	1327	56 01.7	168 42.5	654/668	T 5.0 EBS shelf
15	16				NO DATA		Bad cast
16	17&18	Feb 21	0713	56 17.9	169 34.8	155/170	T 6.0 EBS shelf
17	19	Feb 21	1957	56 32.7	170 35.1	108/113	T 7.0 EBS shelf
18	20	Feb 24	0510	54 14.8	167 16.3	643/1498	T 9.0 Bogoslof
19	21				NO DATA		Bad cast
20	23	Feb 26	0034	54 05.3	168 27.4	557/2350	T 13.0 Bogoslof
21	24&25	Feb 27	0003	53 50.0	168 45.4	203/2078	T 14.0 Bogoslof
22	26	Feb 27	1156	54 00.1	169 02.5	544/2450	T 15.0 Bogoslof
23	27&28	Feb 27	2312	53 12.5	169 00.7	809/896	T 15.0 Bogoslof
24	29	Mar 02	0015	53 56.2	169 10.7	514/1050	T 20.0 Bogoslof
25	30	Mar 02	1356	53 28.1	168 53.9	498/1620	T 21.0 Bogoslof
26	31	Mar 03	1426	54 13.0	168 01.3	511/1609	T 24.0 Bogoslof
27	-	Mar 04			NO DATA		Bad cast
28	-	Mar 04	1405	53 41.9	166 45.5	73/84	Cannery Bay cal
29	32	Mar 08	0738	53 53.8	169 20.8	464/1700	W. Bogoslof Leg 2
30	33	Mar 09	0819	53 01.6	169 17.9	793/927	T 28.0 N. Umnak I
31	34	Mar 10	1530	53 36.2	168 29.2	733/1200	N. Umnak Island
32	G001A	Mar 10	1927	53 07.7	169 00.0	250/273	Grid Station #1
33	G002A	Mar 10	2208	53 30.0	168 58.9	530/1857	Grid Station #2
34	G003A	Mar 11	0202	54 00.2	169 00.0	622/2220	Grid Station #3
35	G003B	Mar 11	0337	54 00.0	169 00.0	598/2000	Grid Station #3
36	G004A	Mar 11	0752	54 30.9	169 00.2	577/1500	Grid Station #4
37	G005A	Mar 11	1403	54 09.9	167 59.2	616/1991	Grid Station #8
38	G005B	Mar 11	1515	54 10.1	167 59.4	655/1992	Grid Station #8
39	G006A	Mar 11	1859	53 40.4	168 00.9	543/710	Grid Station #9
40	G007A				NO DATA		Grid Station #10
41	G008A				NO DATA		Grid Station #11
42	G008B	Mar 12	0436	54 33.1	167 00.4	417/464	Grid Station #11
43	G008C	Mar 12	0525	54 33.3	167 01.9	352/463	Grid Station #11
44	G009A	Mar 12	0937	54 38.9	168 00.4	526/1300	Grid Station #7
45	G010A	Mar 12	1306	55 08.0	168 01.3	494/1086	Grid Station #6
46	G010B	Mar 12	1420	55 08.0	168 00.8	463/1020	Grid Station #6
47	G011A	Mar 12	1821	55 02.5	167 01.4	128/155	Grid Station #12
48	G012A	Mar 12	2138	55 33.2	167 00.5	106/130	Grid Station #13
49	G013A	Mar 13	0127	55 48.6	166 00.0	87/118	Grid Station #14
50	G014A	Mar 13	0445	56 00.5	165 00.4	66/92	Grid Station #20
51	G015A	Mar 13	0808	55 31.7	164 59.9	79/104	Grid Station #19
52	G016A	Mar 13	1135	55 05.5	164 59.2	59/104	Grid Station #18
53	G017A				NO DATA		Grid Station #15
54	G018A	Mar 14	1600	54 19.9	166 01.5	491/550	Grid Station #17
55	G019A	Mar 14	1905	54 48.9	166 00.0	158/165	Grid Station #16
56	G019B	Mar 14	1929	54 49.2	165 59.8	155/160	Grid Station #16
57	G020A	Mar 14	2337	54 26.5	166 31.3	520/547	Grid Station #21
58	35	Mar 15	0355	54 23.5	166 10.5	399/604	N. Akutan I.

Table 11. Inventory of XBT casts made during the winter 1991 Bering Sea pollock survey, Miller Freeman 91-1.

CAST NO.	HAUL NO.	DATE (1991)	TIME (GMT)	POSITION		BOTTOM DEPTH (M)	COMMENT
				LAT (N)	LONG (W)		
6	-	Feb 11	1621	58 06.5	153 30.6	226	Shelikof Strait
7	-	Feb 12	0224	56 00.8	154 26.2	473	E. of Chirikof I.
8	4	Feb 13	0855	55 59.8	154 23.5	439	E. of Chirikof I.
9	-	Feb 15	2135	54 32.8	166 16.5	458	EBS shelf T 1.0
10	-				NO DATA		Bad cast
11	-	Feb 16	1812	56 16.9	162 56.4	79	EBS shelf T 1.1
12	7	Feb 16	2346	56 16.3	163 33.1	84	EBS shelf T 2.0
13	-	Feb 17	0739	55 29.4	165 36.8	113	EBS shelf T 2.0
14	-	Feb 17	2129	54 56.3	166 44.9	159	EBS shelf T 2.0
15	-	Feb 18	0104	55 00.6	167 40.9	446	EBS shelf T 2.1
16	-	Feb 18	1307	55 47.5	166 15.0	124	EBS shelf T 3.0
17	-	Feb 18	2243	56 11.1	166 06.9	103	EBS shelf T 3.1
18	-				NO DATA		Bad cast
19	-	Feb 20	0918	55 32.0	168 27.4	354	EBS shelf T 4.2
20	-				NO DATA		Bad cast
21	-	Feb 20	1255	55 44.6	168 58.1	891	EBS shelf T 4.2
22	-	Feb 21	0043	56 13.3	168 15.4	152	EBS shelf T 5.0
23	-	Feb 21	0520	56 29.4	167 55.7	115	EBS shelf T 5.1
24	-	Feb 21	2259	56 05.2	171 03.1	1497	EBS shelf T 6.1
25	-	Feb 22	0206	56 19.8	171 08.2	134	EBS shelf T 7.0
26	-				NO DATA		Bad cast
27	-				NO DATA		Bad cast
28	21	Feb 24	2302	54 15.1	167 33.9	1620	Bogoslof T 10.0
29	22	Feb 25	2127	54 29.8	168 09.1	1700	Bogoslof T 12.0
30	-	Feb 27	1146	53 54.8	168 44.2	2230	Bogoslof T 14.0
31	-	Feb 28	1504	53 47.6	169 19.3	1579	Bogoslof T 16.0
32	-				NO DATA		Bad cast
33	-	Mar 1	1524	53 50.9	170 12.9	1944	Is 4 Mnts T 19.0
34	-	Mar 2	1508	54 10.7	168 53.7	2614	Bogoslof T 21.0
35	-				NO DATA		Bad cast
36	-	Mar 2	0702	54 18.3	168 36.3	1830	Bogoslof T 22.0
37	-				NO DATA		Bad cast
38	-	Mar 3	1626	53 34.1	168 15.5	318	Bogoslof T 23.0
39	-	Mar 4	0319	54 35.7	167 43.2	834	Bogoslof T 25.0
40	-	Mar 4	0555	54 06.8	167 42.8	1800	Bogoslof T 25.0
41	-	Mar 5	1417	53 56.4	167 07.2	340	Bogoslof Transit
42	-	Mar 9	1812	53 05.0	169 18.2	1200	N. Umnak I T 28.0
43	-				NO DATA		Bad cast
44	-	Mar 10	1229	53 36.6	168 45.2	1540	N. Umnak I T 30.0
45	-	Mar 11	1522	54 22.7	168 59.8	1810	N. Umnak I Bongo
46	-				NO DATA		Bad cast
47	-				NO DATA		Bad cast
48	-	Mar 12	2053	54 58.1	168 00.4	1538	N. Umnak I Bongo
49	-	Mar 15	1411	54 17.4	166 13.6	680	N. Akutan I.

Note: casts 1-5 were made during transit to Kodiak, AK, prior to the start of the survey.

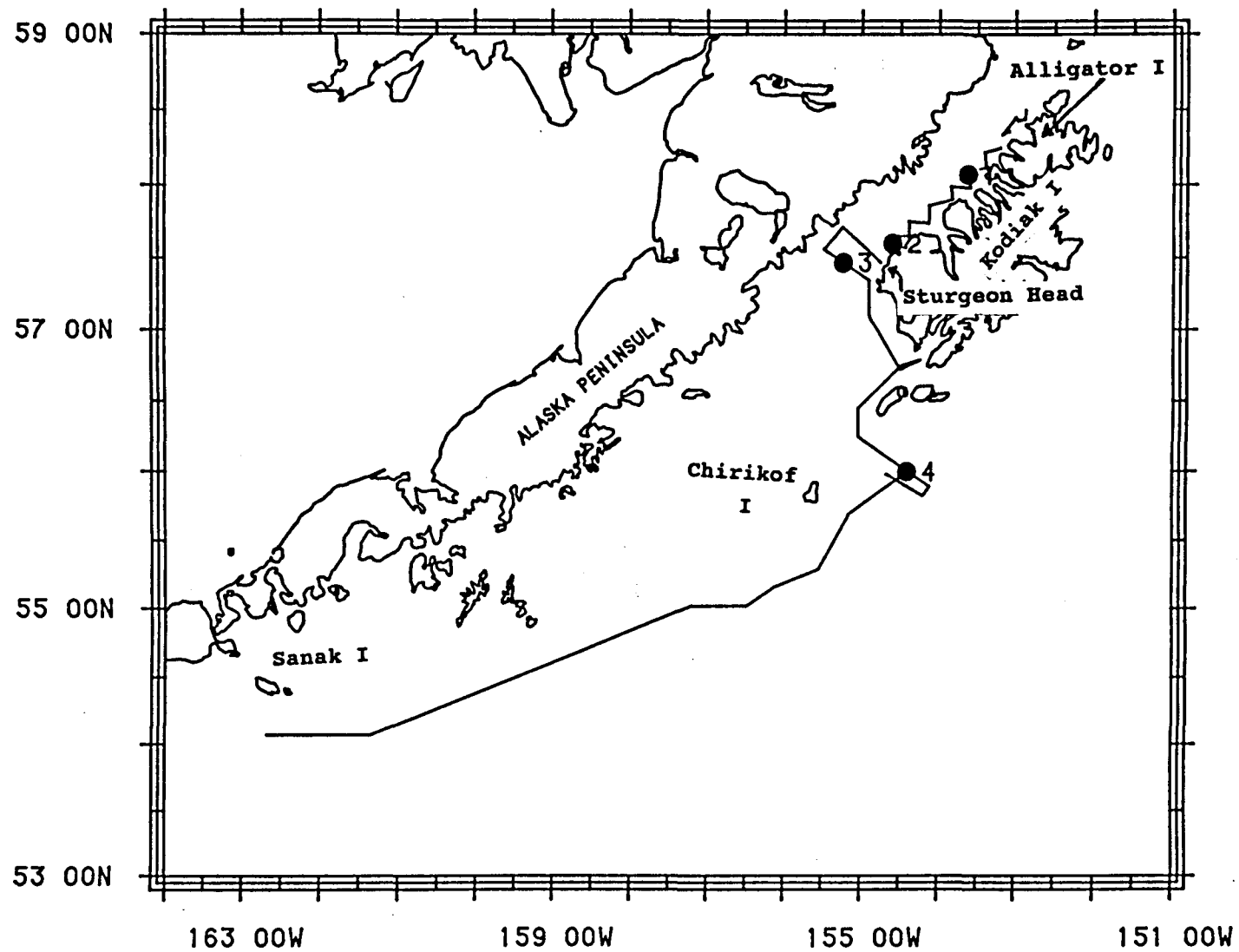


Figure 1. Survey trackline and haul stations in the Gulf of Alaska during Miller Freeman cruise 91-1.

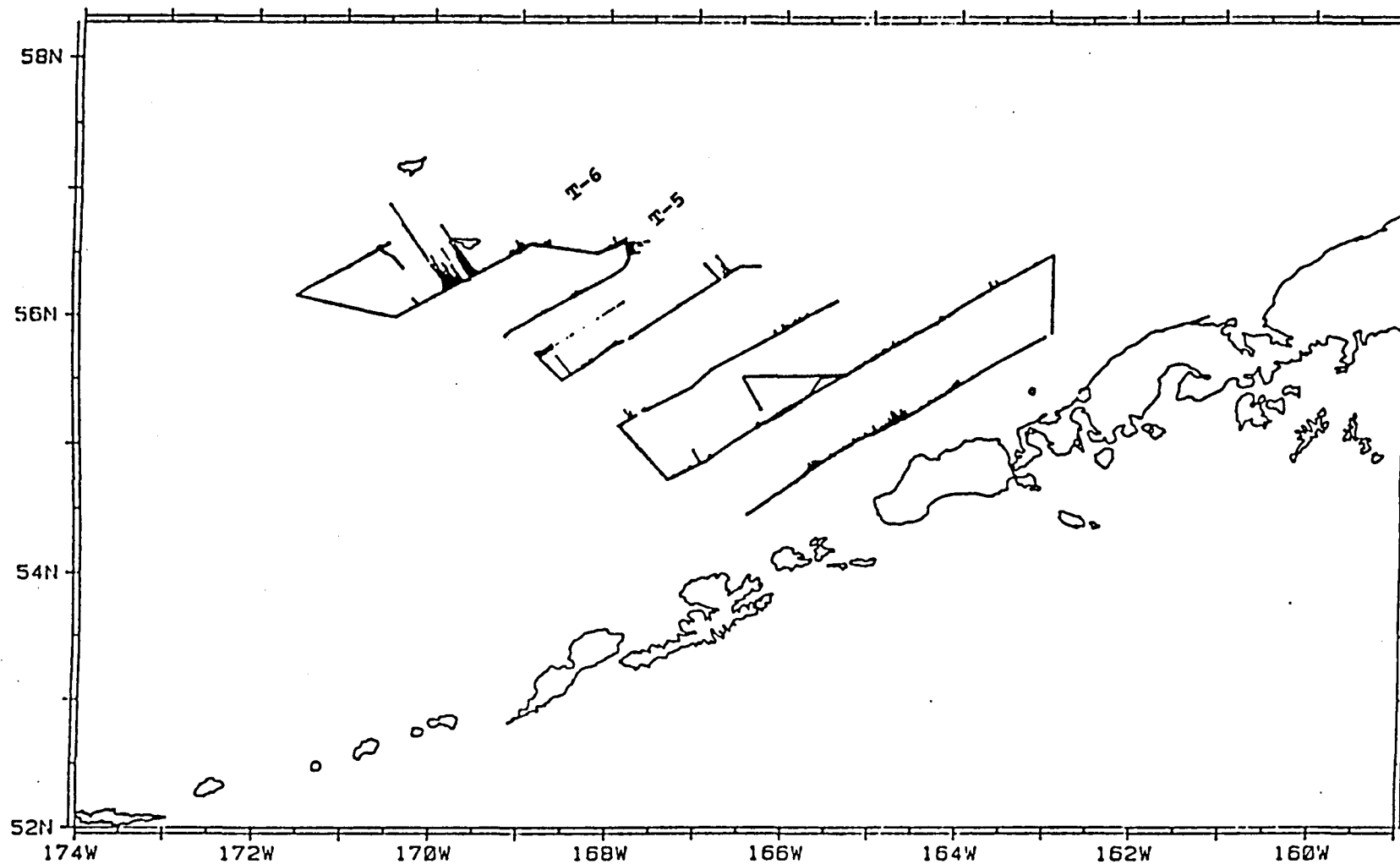


Figure 2. Southeast Bering Sea shelf survey trackline during Miller Freeman cruise 91-1. Deflections off transect lines indicate relative fish density.

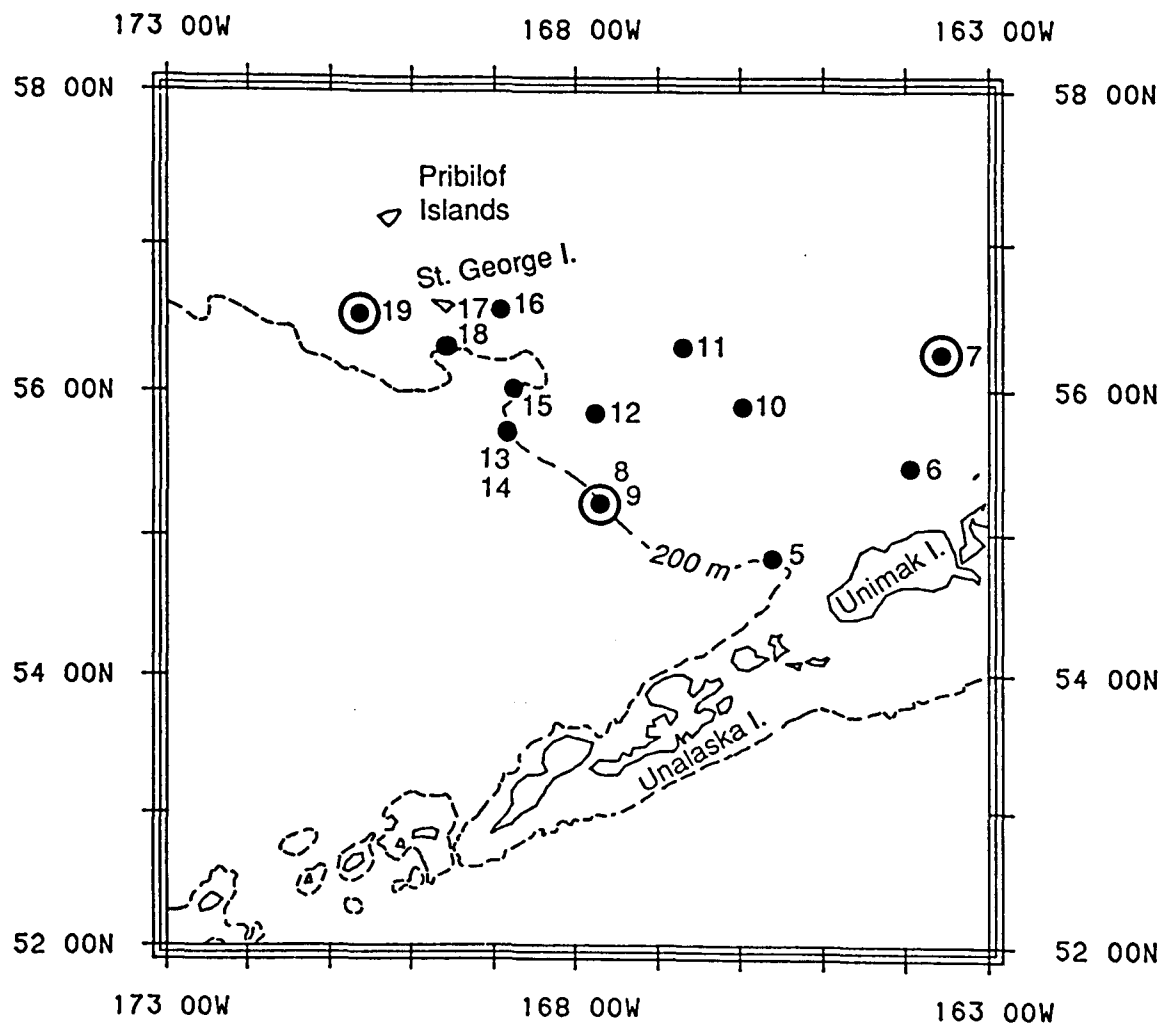


Figure 3. Southeast Bering Sea shelf haul positions during Miller Freeman cruise 91-1. Bottom hauls are circled.

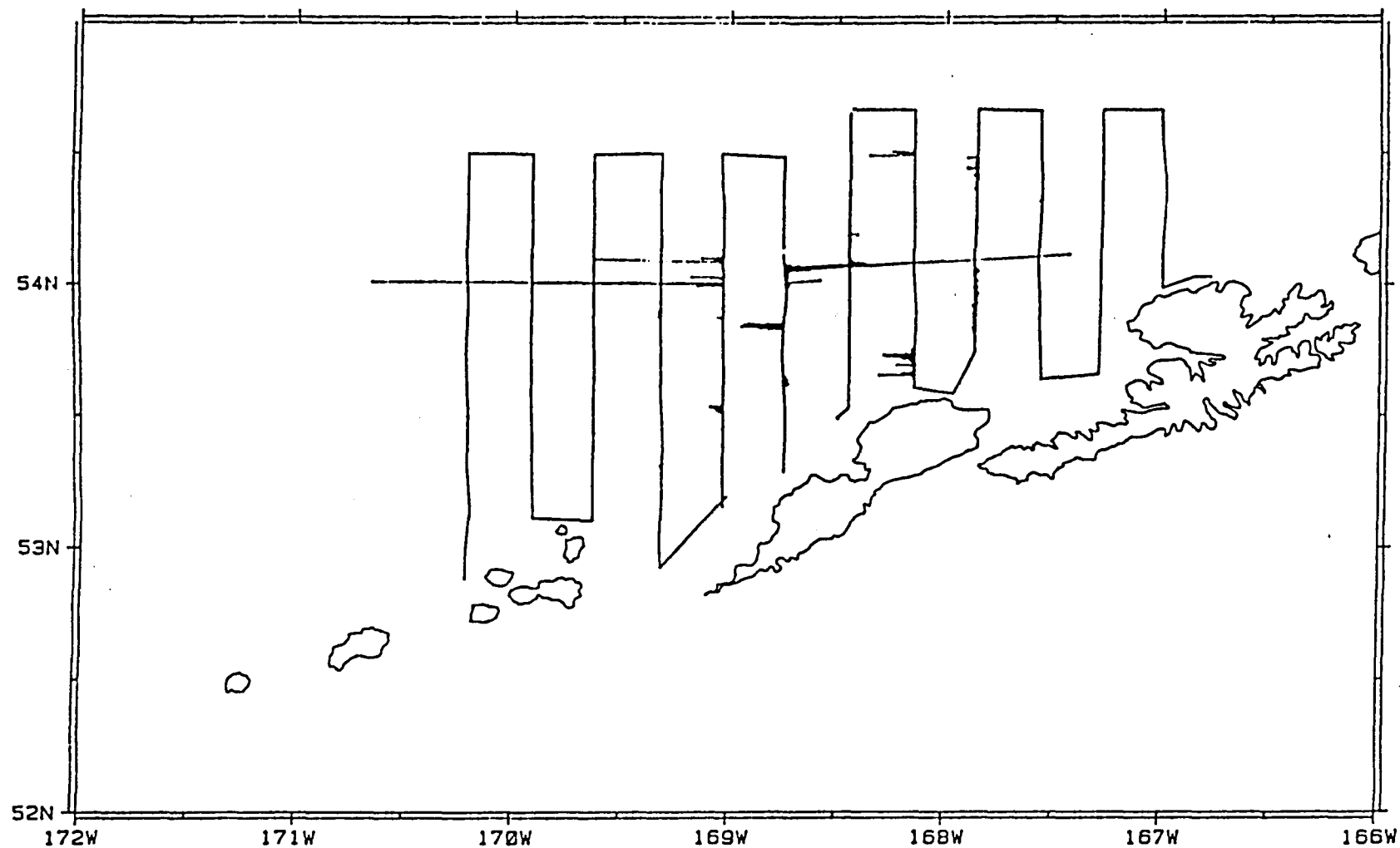


Figure 4. Bogoslof Island area survey trackline (Leg 1, pass 1), Miller Freeman cruise 91-1. Deflections off transect lines indicate relative fish density.

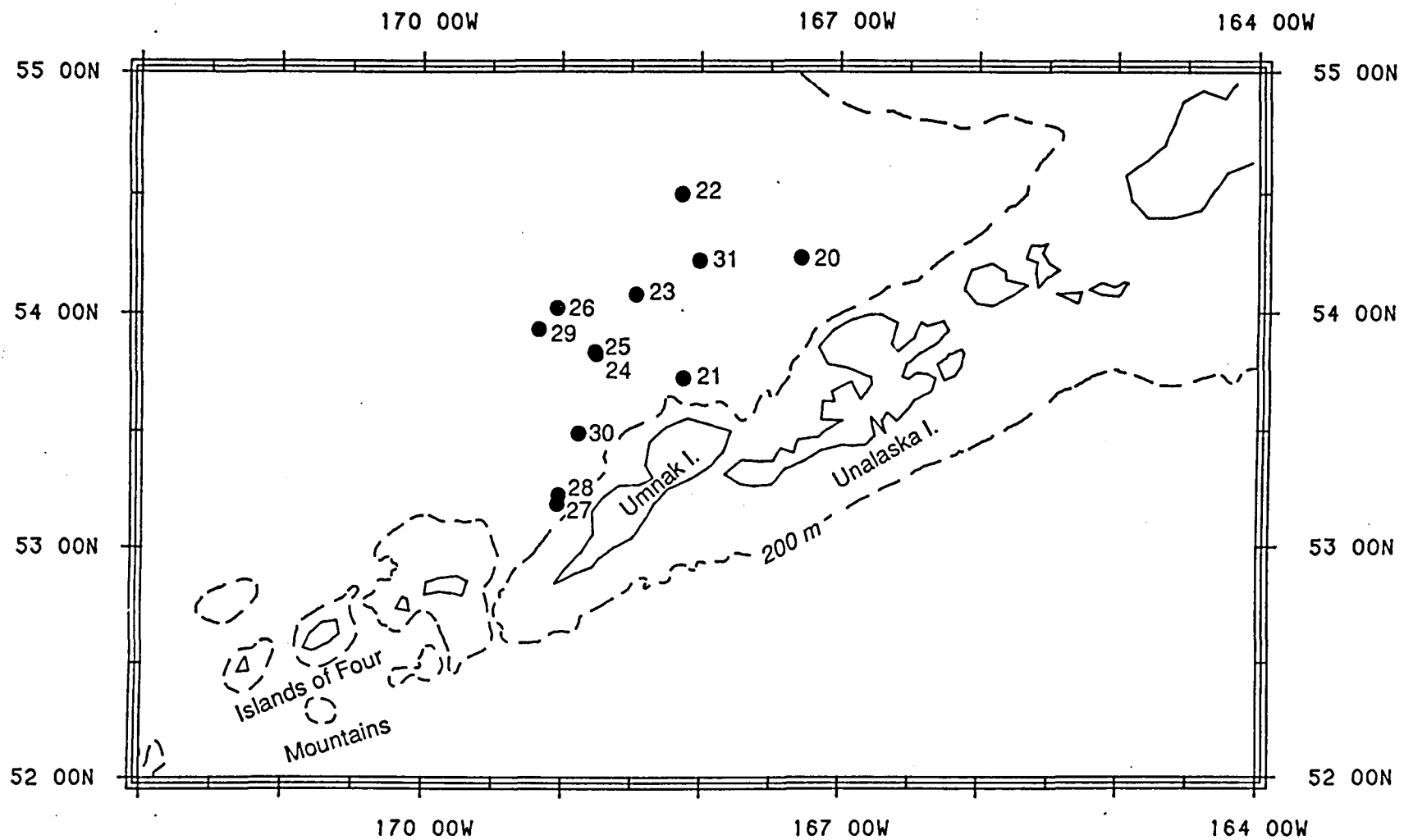


Figure 5. Bogoslof Island area haul positions, Leg 1, passes 1 and 2, Miller Freeman cruise 91-1.

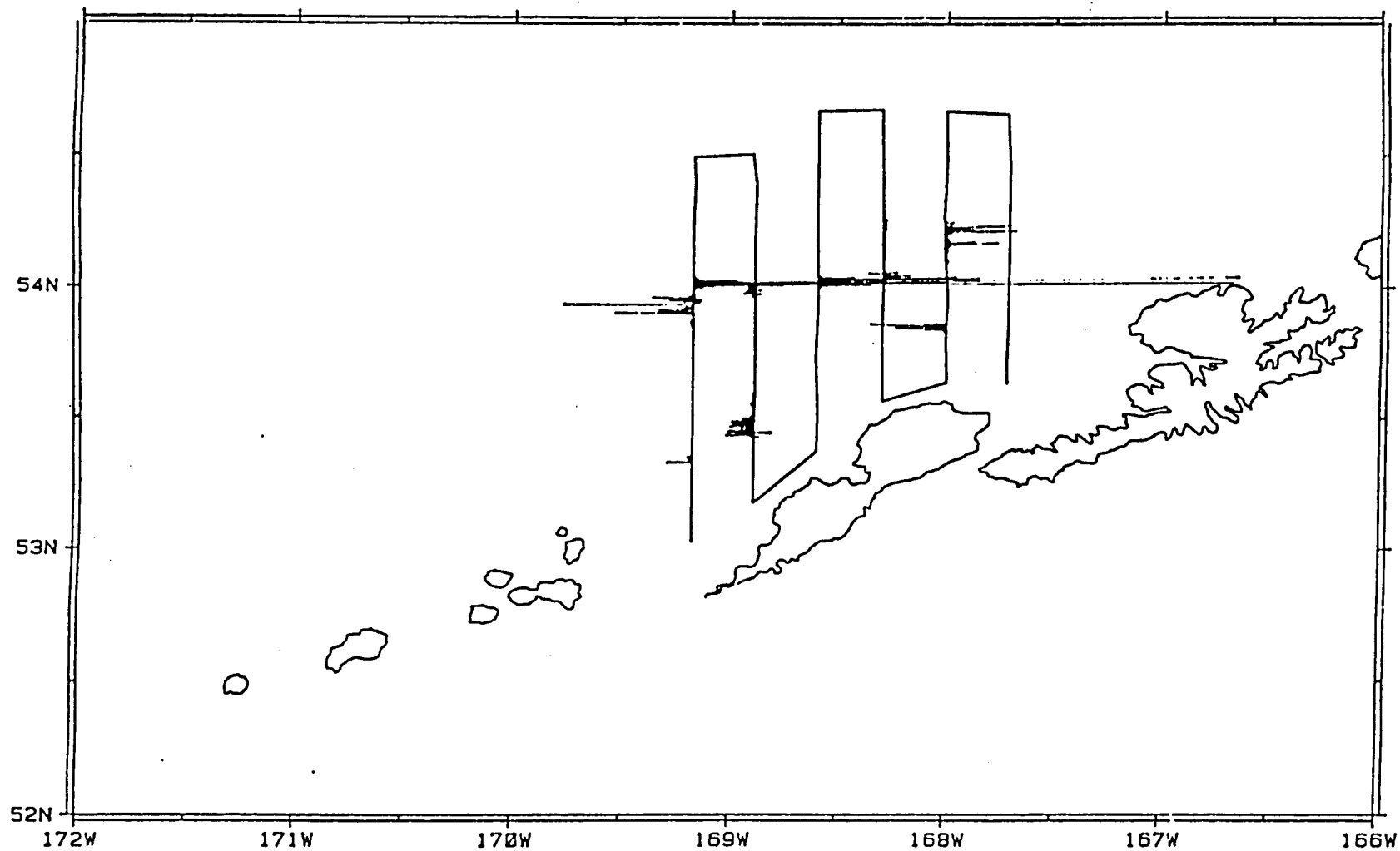


Figure 6. Bogoslof Island area survey trackline (Leg 1, pass 2), Miller Freeman cruise 91-1. Deflections off transect lines indicate relative fish density.

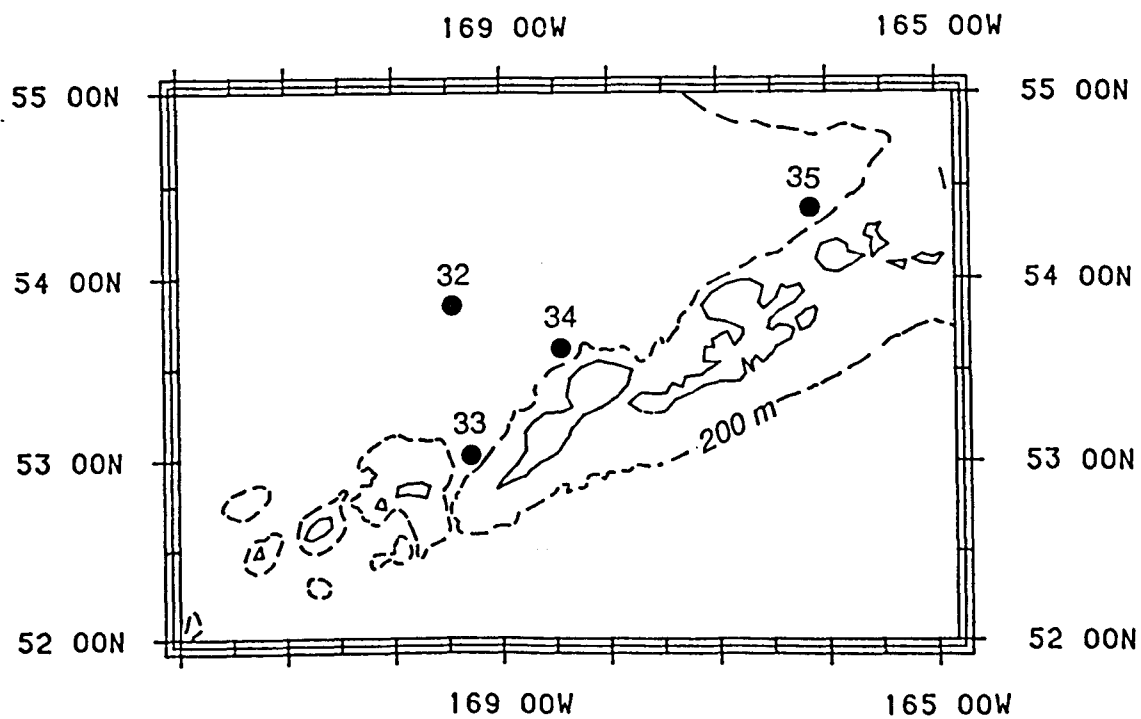
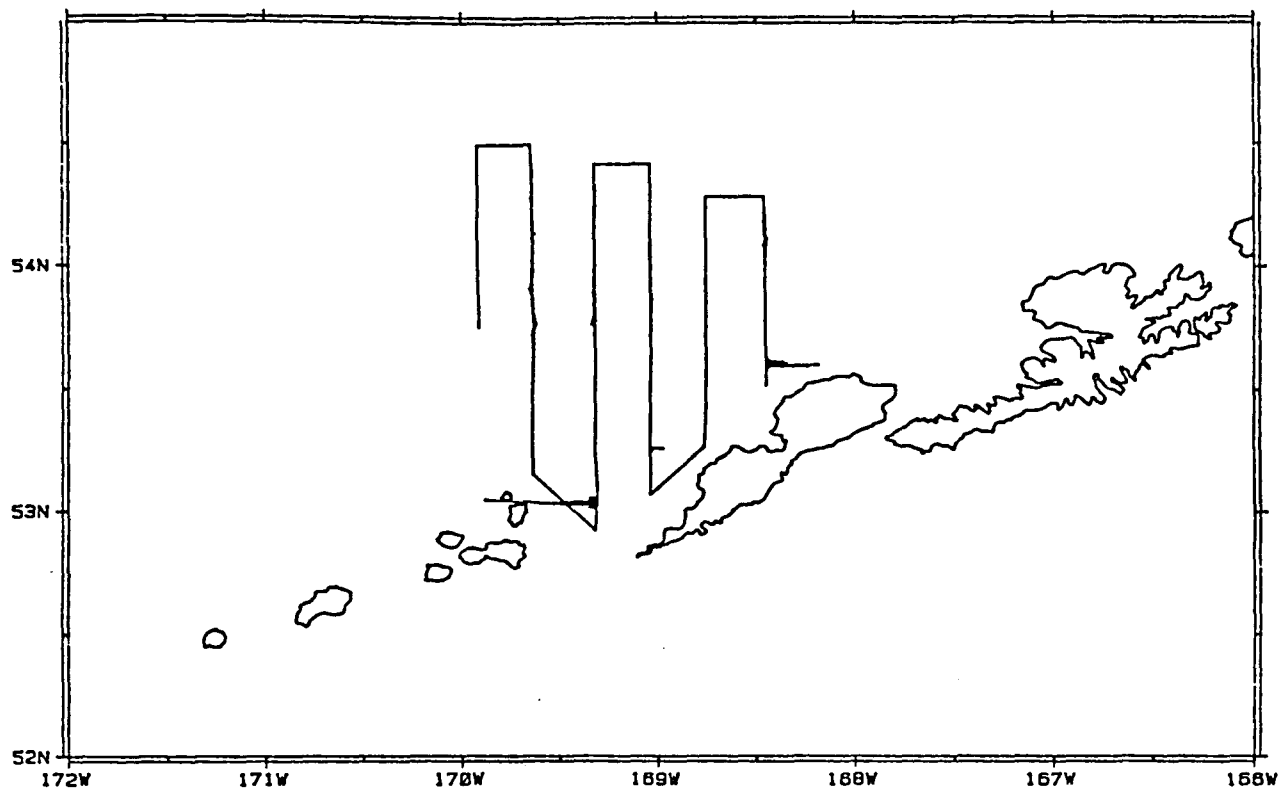


Figure 7. Bogoslof Island area survey trackline, Leg 2, Miller Freeman cruise 91-1 (top). Deflections off transect lines indicate relative fish density. Haul positions for Leg 2 (bottom).

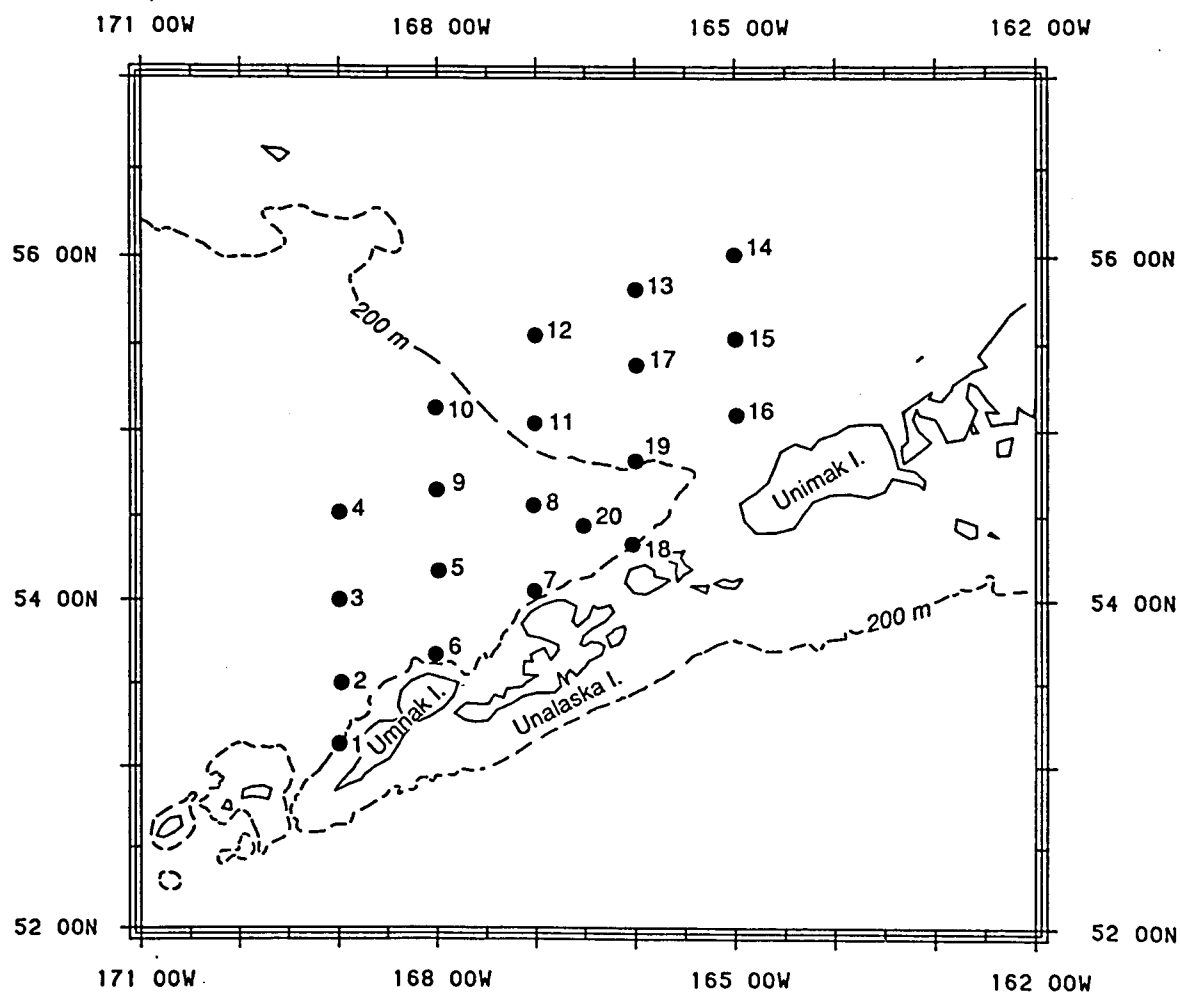
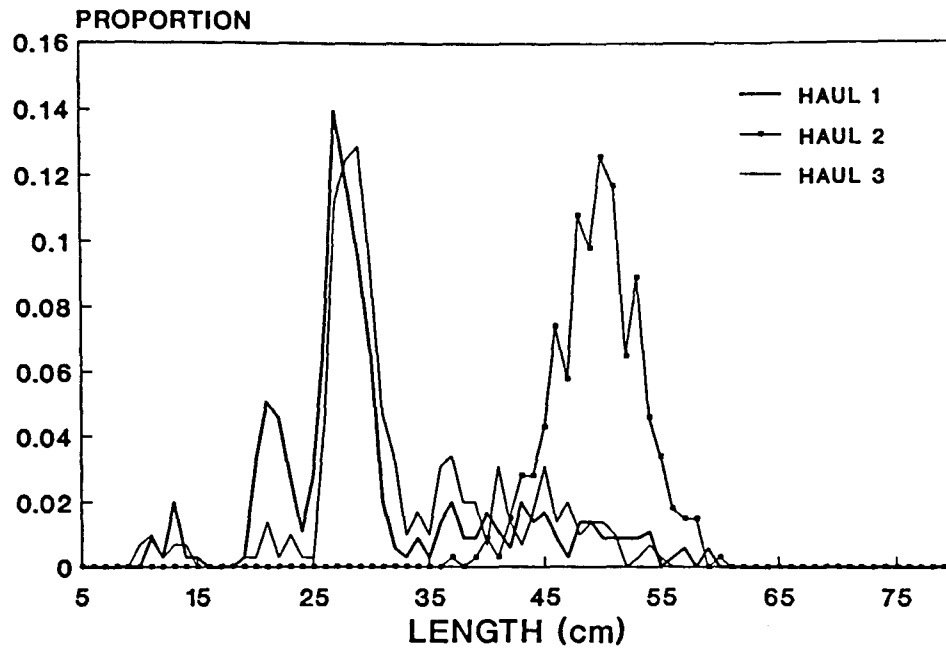


Figure 8. Bongo stations for ichthyoplankton survey, Miller Freeman cruise 91-1.

## SHELIKOF STRAIT



## CHIRIKOF

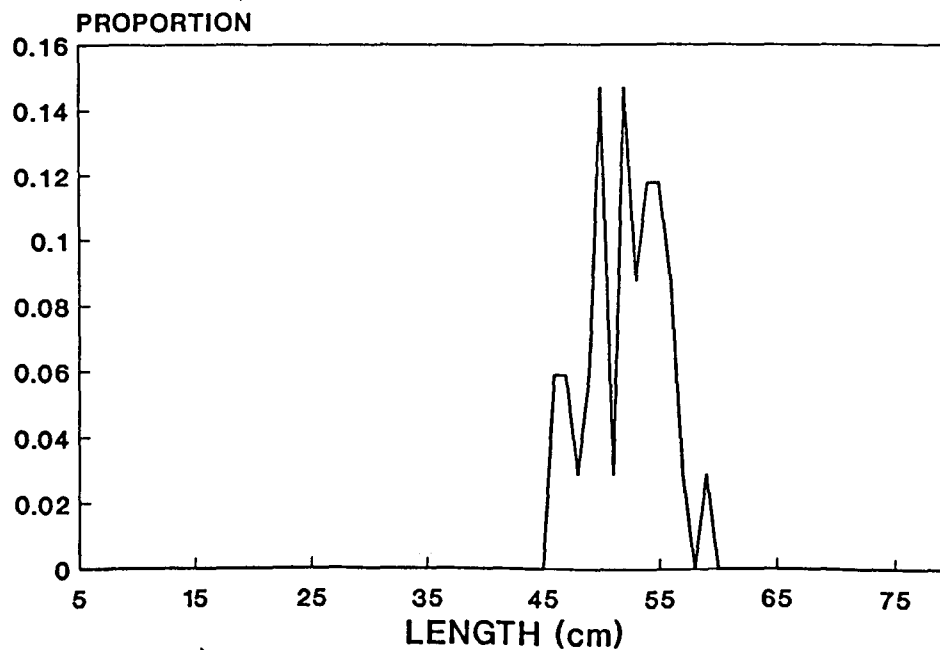
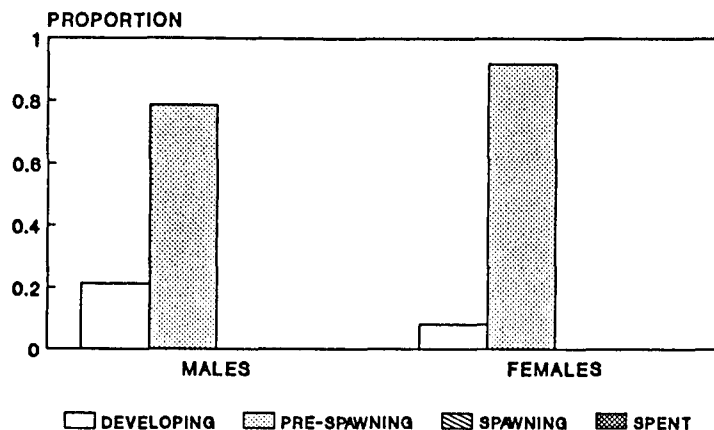
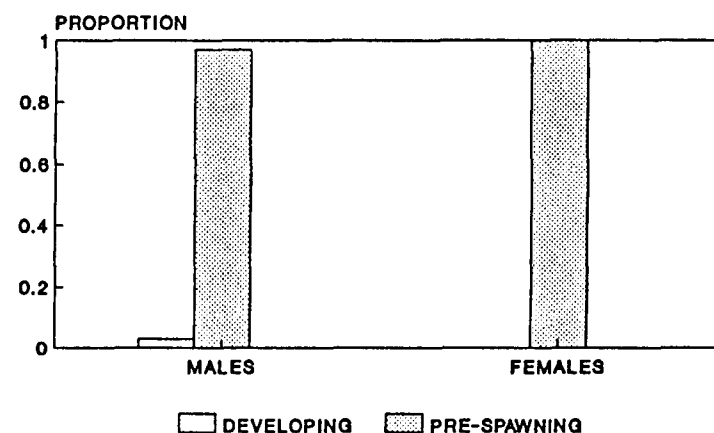


Figure 9. Relative proportion of pollock at length from haul samples in the Gulf of Alaska, unweighted by population size, from Miller Freeman cruise 91-1.

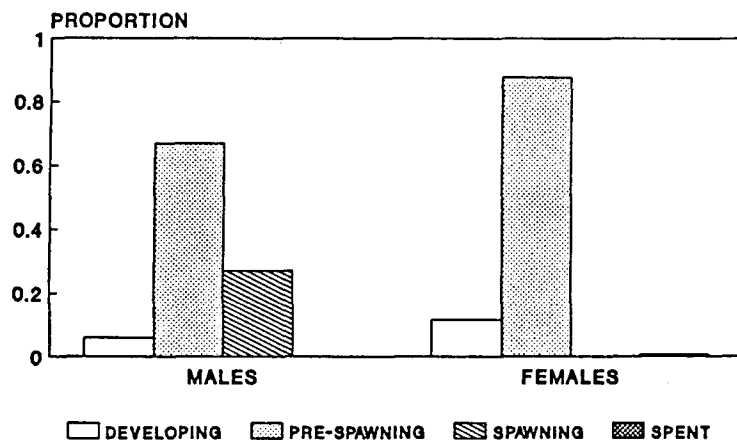
## SHELIKOF STRAIT MIDWATER HAULS



## CHIRIKOF MIDWATER HAUL



## SOUTHEAST SHELF MIDWATER HAULS



## SOUTHEAST SHELF BOTTOM HAULS

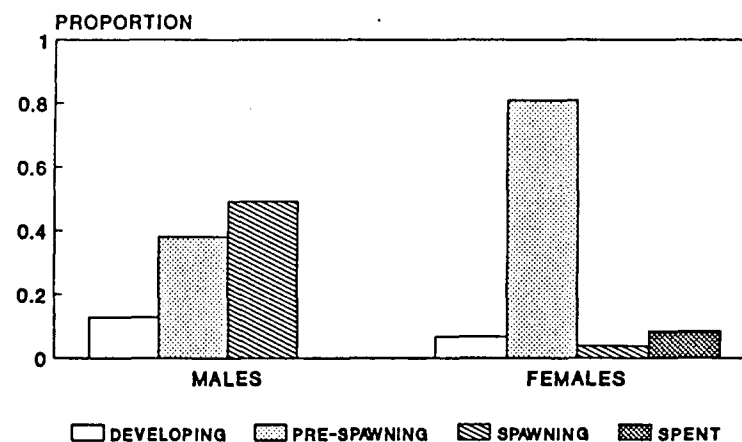


Figure 10. Maturity stages for pollock over 34 cm in length sampled in three trawl hauls from Shelikof Strait, one haul near Chirikof Island, eleven midwater hauls from the southeast Bering Sea shelf and three southeast Bering Sea shelf bottom hauls, from Miller Freeman cruise 91-1.

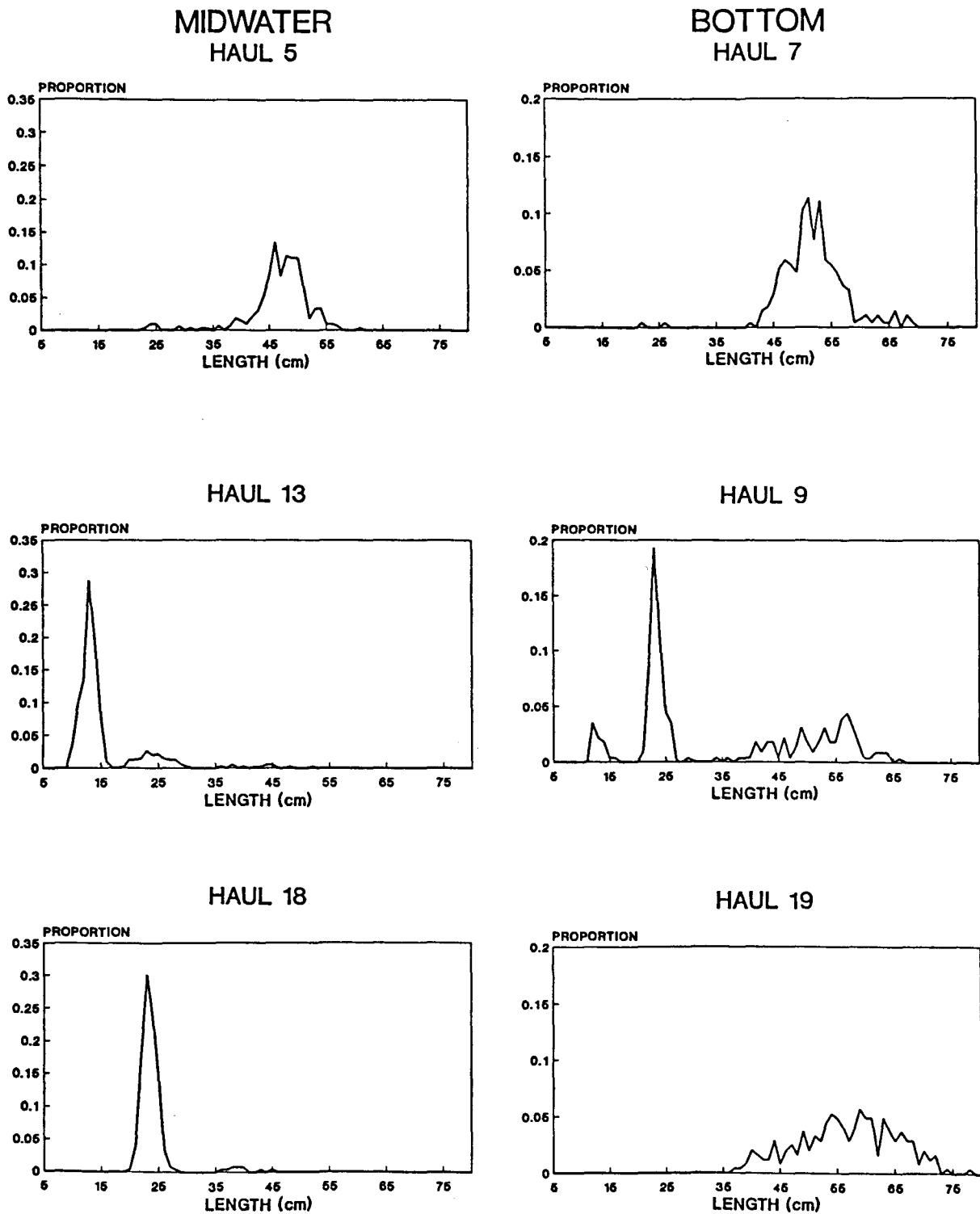


Figure 11. Relative proportion of pollock at length from haul samples on the southeast Bering Sea shelf, unweighted by population size, from Miller Freeman cruise 91-1.

# SOUTHEAST SHELF

FEB. 15-22

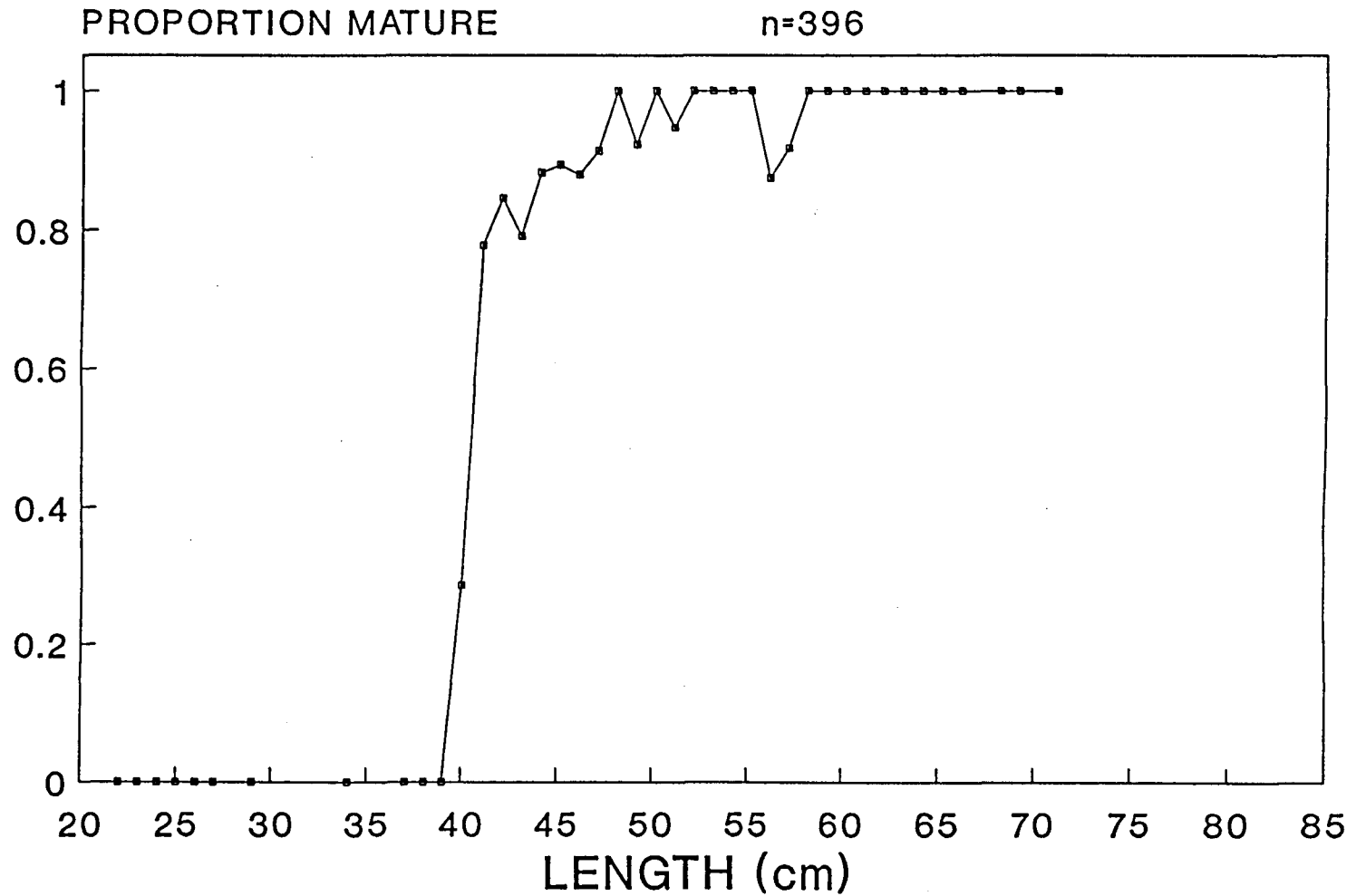


Figure 12. Maturity-at-length for female pollock collected from the southeast Bering Sea shelf during Miller Freeman cruise 91-1.

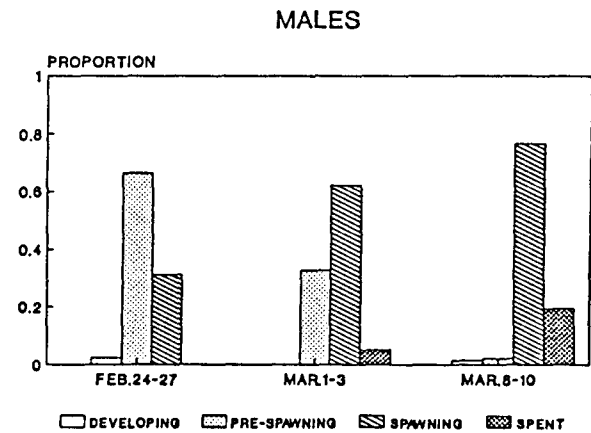
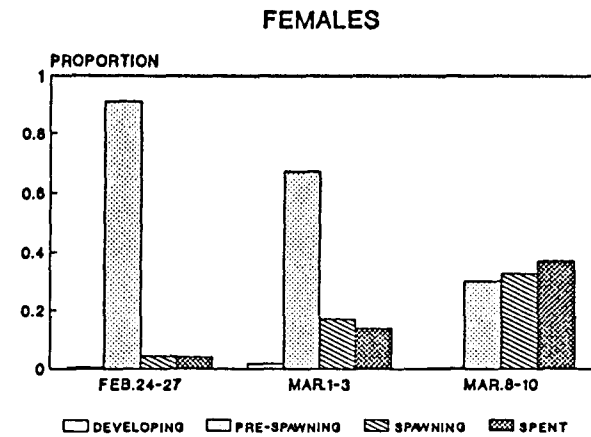
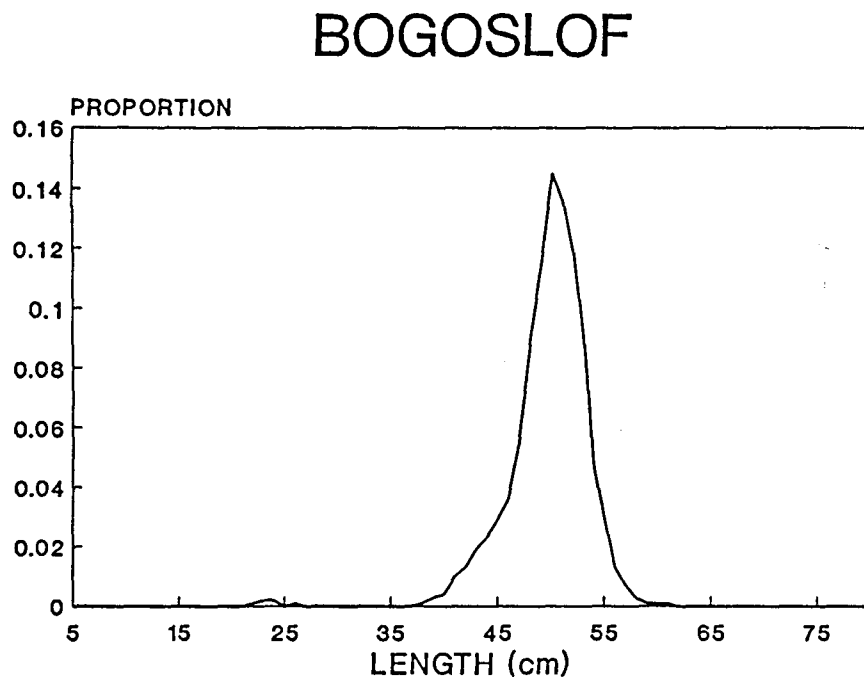


Figure 13. Relative proportion of pollock at length from all hauls taken near Bogoslof Island (left), and maturity stages for pollock over 34 cm in length sampled in trawl hauls from the Bogoslof Island region at three different time periods (right), from Miller Freeman cruise 91-1.